Expanding The Seasonal Potted Plant Floral Market In North America With Containerized *Protea cynaroides* L.

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EXECUTIVE SUMMARY

The existing floriculture market for Christmas potted plants has been dominated by the Poinsettia (*Euphorbia pulcherrima)* for an astounding 160 years. Most recent USDA statistics show that the Poinsettia/Christmas market accounts for 23% of all potted plants sales in the US or $144 Million annually. It is the number 1 selling potted plant with Easter lilies a distant second ($22 Million in sales). The average lifespan of a floriculture product (cultivar) is one to two years. Poinsettia is way over due for displacement, but a competing plant with similar Christmas tradition-based credentials has never surfaced. An abundance of money is spent by consumers on

floral decorations for the Christmas holiday. That market is not saturated – consumers are limited in their buying by the lack of choice: the only option is a Poinsettia. The Christmas market is a niche with huge profit potential for an alternative or supplemental that offers novelty, beauty, and the symbolic Christmas connection. The commercial development and marketing of a dwarf variety of *Protea cynaroides* L. meets those criteria. This paper discusses the background information on *P. cynaroides*, a marketing rationale for that plant to compete with or alongside Poinsettias for Christmas plant sales, and a discussion of what steps can be taken to launch a successful production and marketing program to tap into and possibly capture the rich profit potential of the Christmas floral potted plant market to expand the overall US floriculture market beyond its present levels.

I. INTRODUCTION

A. Study Species.

Ironically, one of the most uniquely architectural, visually exotic, and highly prized flowers brought to the world market just within the last fifty years is one that recent fossil DNA testing revealed has grown in the wild for over 100 million years - *Protea cynaroides* Linnaeus (Barker et al. 2007). This contemporary of *Tyrannosaurus Rex* has long been available for commercialization but until recently that potential remained untapped.

Protea cynaroides L. is commonly known as the “King Protea” for its large inflorescence diameter of nearly 30cm. These unusual and strikingly beautiful flowers have a visual appeal that transcends customer generations – they simultaneously appear prehistoric and futuristically out-of-this-world. In addition to an unusual appearance, their huge commercial potential is also enhanced by the fact that they are not widely known to the general North American population.

Why? *P. cynaroides* is indigenous only to the southern hemisphere. Global commercial cultivation has been highly restricted because of the plant's limiting climatic and soil requirements. This makes the inflorescences, which are currently sold only as cut flowers, a high-end product known and purchased by a very limited and equally high-end customer base. But to see a *Protea cynaroides* L. is to love it, and to love it is to want it.

Besides the stunning visual impact of the King Protea inflorescence specimen itself in its size and exotic look, this flower has a tactile appeal that draws the observer for a closer examination. It is so unusual that it is hard to believe it is real. Viewed from the side, the King Protea looks like a red-hued goblet with its exterior covered in layers of crimson-colored velvety spears whose points project above the center of the flower. Viewed from above, the pointed spears appear to form a corona around a convex, wide and creamy white fuzzy center, giving the impression of a multi-pointed, three-dimensional star. Bear in mind that the normal extended summer blooming time of *P. cynaroides* L. in the southern hemisphere (November through June) coincides with the northern hemisphere's winter holidays, especially Christmas (Prinzing, 2015); the flower's natural blooming hues combine red/pinks and white/cream (universally accepted as traditional winter holiday colors) (Madden, 2015); and it's star-like shape is an inherent one in the holiday decorations/themes of most major religions. The number and variety of seasonal potted plants specifically marketed for the Christmas/winter season in the northern hemisphere is very limited in North America – mostly restricted to the Christmas poinsettia (*Euphorbia pulcherrima)*, holly (*Ilex aquifolium*), hellebores (*Helleborus niger*), paper whites (*Narcissus tazetta*), amaryllis (*Hippeastrum reginae*), cyclamen (*Cyclamen persicum*), and Christmas cactus (*Schlumbergera truncate*) (Madden, 2015). The North American market alone provides huge potential for a new seasonal offering (Seaton et al. 2014). Creating a new marketing demand for a potted *P. cynaroides* cultivar as an exotic, excitingly new and different alternative or complement to the existing traditional seasonal indoor potted offerings has the potential not only to create a new product line and expand an already existing customer base in horticultural industries, but also to expand the floriculture market in a currently untapped direction.

Taxonomic Classification and Geographic Distribution in the Wild.

The taxonomic classification of *Protea cynaroides* is displayed in Table 1 wherein the species falls within the polypetalous Rosidae Sub-class.

Table 1. Taxonomic classification of *Protea cynaroides*

Kingdom	Plantae	
Sub-Kingdom	Tracheophyta	Vascular plants
Super-Division	Spermatophyta	Seed plants
Division	Magnoliophyta	Flowering plants
Class	Magnoliopsida	Dicotyledons
Sub-Class	Rosidae	
Order	Proteales	
Family	Proteaceae	
Genus	Protea L.	
Species	*Protea cynaroides* L.	

This species is known by several common names that are descriptive of its flower size (King Protea, Giant Protea) and the copious amounts of nectar each flower produces (Honeypot, King

Sugarbush). The scientific binomial name reflects other features of the plant. Since there was and is such a huge variety in size, shape, colors and forms in the related plants that form this genus, Swedish botanist Carl von Linne (Linnaeus) gave it the name "*Protea"* after the mythological Greek god, Proteus, whose special ability it was to change his body shape and form at will. Linnaeus selected the species name "*cynaroides"* because the plant's developing flower head so closely resembled the appearance of the globe artichoke, *Cynara cardunculus* L. (Vogts, 1958).

Although introduced into and now cultivated on six of the seven continents, *Protea cynaroides* is native to a narrow crescent-shaped strip of coastal shrub land in the extreme southern tip of South Africa known as the "fynbos" which is also considered to be the location of origin of the species. This area is identified as the Cape Floral Kingdom or Floral Capensis, the smallest and richest in plant diversity of six such designated plant kingdoms in the world (Coetzee et al. 2001). The fynbos biome is incorporated in a 100km-200km wide swath of coastal lands cupping the southern tip of South Africa's Cape Province from Clanwilliam in the west, south to Cape Town, and east to Grahamstown (Coetzee et al. 2001). The area is roughly 980km east to west and approximately 230km north and south between latitudes 32.1786S and 33.3S. (See Figure 1). Elevations in this area range from sea level to 1,500m high in the several coastal mountain ranges. In this native habitat, *P. cynariodes* is never more than 200km from the sea and the coastal airflow, which is so important to its survival. The plant grows wild among vegetation that is prone to wild fires and has adapted to this natural occurrence with its evolved stem and root structure, discussed later in this paper. The species has naturalized in the wild, but it is not invasive. The King Protea is, in fact, highly identifiable with and symbolic of South Africa. It is the official national flower of the country. The image of the flower appears on the obverse side of several series of South Africa's coins.

Figure 1. Origin of *Protea cynaroides* L. in South Africa's Cape Floral Kingdom. Source: web. Encyclopaedia Britannica Online For Kids. http://kids.britannica.com/elementary/art-184802

The climatic conditions in this area of origin offer a variable opportunistic range for successful growth of *Protea cynaroides*. The plants grow on coastal mountain ranges where soil is cool, temperatures can drop to freezing for a very limited period of time, and snow falls. They also do well in low coastal areas with moderate temperatures. Common climatic features in these geographic areas are constant breezes and abundant sunshine. *Protea cynaroides* does not do as well in more removed and interior areas. High humidity, stagnant air, or extended periods of rain will literally kill the plants, but they can tolerate dry heat and dry cold well. Overall, King Protea flourishes in a sunny, breezy Mediterranean climate. Climate, however, is only one of two critical factors in successful cultivation of this species.

The second factor is soil type. *Protea cynaroides*, like other members of the *Protea* genus, are highly specific to soils that are mineral-poor, even deficient in the commonly required plant nutrients of other genera (Brits, 1984). They also require soil that is slightly acidic with a pH between 5 and 7; the soil must also be free draining (Ferguson 1999). Optimal growing conditions are sandy loam-type granite-based topsoils on subsoils that are stony, especially those rich in volcanic or granite-decomposed rock. Ironically, the pH "sweet spot" for the species is not sweet at all but a slightly acidic pH of 5.4 to 5.8 (Vogts, 1958). Clay soils or those rich in compost or humus and otherwise desirable garden soils for most plants will not be suitable for growing *P. cynaroides*. Soil or media amendments with any phosphates or soils that have high water holding properties will be detrimental or lethal to King Protea due to the plant's proteoid root structure and mechanism as described below. Good water drainage is an essential soil property as the plant cannot tolerate waterlogged roots. A rugged survivor, it will thrive in areas that other plants find intolerable, including on the sides of steep escarpments, which is currently a favored location for commercial plantings.

Protea cynaroides grows as an evergreen shrub with shiny somewhat narrow green leaves tinged with red on the edges. The shape of the leaves appears to be influenced by both the variety and the location of origin of the source plants (Vogts, 1958). Leaves are never serrated, and usually of a shape somewhat between round and oblong, evidently an adaptation to facilitate water conservation in the arid soils on which they grow. King Protea leaves are leathery and lignified (Leonhardt and Criley, 1999) which seem to provide a defense mechanism against pests who find them indigestible (Rebelo, 2001). Leaves grow from long stalks that emerge from smooth-wooded branches. Thick underground stems called lignotubers hold dormant buds that will be activated by fire or other injury to the plant above ground. *P. cynaroides* can grow to a height of 1.8m and, if left unpruned, an equal width. However, most frequently under managed cultivation, the plant grows approximately 1.0m high and 0.8m wide. As the shrub gets older, it can become scraggly in shape if left unpruned. Its natural life span is approximately 5 to 15 years (McNabb, 2015).

The flower heads are actually inflorescences or clusters of smaller florets that are characterized by involucral bracts, specialized colorful leaves in hues of cream, pink or red which are covered in a furry-like hair that adds a deeper dimension and almost silvery caste to the flower (Betty Ziskovsky, personal observation). The bracts are arranged in whorls around the base of the inflorescence, adding to the visual impression of a very large and complex flower. Indeed, the *P. cynaroides* inflorescence, also known as a capitulum, is quite large, from 12.7cm – 20.32cm in length with diameters between 12.7cm. – 22.86cm (Figure 2). These flower heads do not have petals and sepals, but rather four tepals, which make up the perianth (Leonhardt and Criley, 1999). The true flowers that make up the larger heads are only about 7cm long, much shorter than the surrounding colored bracts (Vogts, 1958), giving the appearance of a fuzzy “ice cream cone” (true flowers) packaged in a surrounding colored wrapper of several layers with uniform jagged edges (involucral bracts) which one would peel back to frame the “cone” before eating. The flower initiates opening from the outside toward the center with the tepals first curling back to expose the styles and subsequently the stigmas. The flowers are protandrous, with pollen maturing and being released from the flowering plant during anthesis somewhat before the stigma becomes fully mature, which assists in cross-pollination (Leonhardt and Criley, 1999). Pollination is also aided by the copious amounts of nectar produced by the flowers, attracting both birds and bees to visit multiple flowers, thereby exchanging pollen among various plants. Flowers form from terminal buds, and this location plus the size of the inflorescences make a spectacular presentation on a mature plant since the flowers are not hidden by foliage, but are displayed on top of it.

Figure 2. *Protea cynaroides* showing its size, natural presentation, foliage, and inflorescence involucral bracts. Photo credit: Betty Ziskovsky.

Plants at age 2.5 to 3.5 years will develop their first flower heads. A single, terminal inflorescence is produced in the first flowering year, two flower heads the second flowering year, and then from six to nine flower heads the third year with larger numbers each subsequent year. It should be noted that the size of the inflorescence seems to depend somewhat on the number of flower heads a plant produces in a blooming season – the greater the number of blooms, the smaller the size of the individual flower heads (Vogts, 1958). *P. cynaroides* has an extended bloom time of several months in its natural habitat.

All *Proteas*, including *P. cynaroides*, have a specialized network of roots, which are characteristic of the genus (Leonhardt and Criley, 1999). These densely clustered mats of short, finely haired rootlets are formed in a layer about 2-5cm thick that lies just below the soil surface. This root system adaptation by the plant efficiently derives essential nutrients, especially phosphorus, from native nutrient poor soils and is referred to as a proteoid root system. Because proteoid roots are so close to the surface, they can be easily damaged by any form of soil disruption, or by the addition of any level of phosphates, the latter easily causing death of the plant. A central taproot is also generated. Its functions are to both anchor the shrub as well as provide access to deeper sources of water during periods of drought.

II. CROP HISTORY

A. Breeding & Domestication.

Plant collecting is not a recent phenomenon. Finding new and novel plants, bringing them to a new location to be cultivated and enjoyed can be traced back to ancient times. Circa 600 B.C., it is believed that King Nebuchadnezzar II commissioned the building of the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World, and had it stocked with foreign plants pleasing to the eye as a gift for his foreign-born wife, Queen Amytis, who missed the green of her former homeland in the arid desert of present day Iraq. His endeavor has been repeated on both smaller and larger scales ever since.

P. cynaroides was first described and sketched before it ever had a name by a Flemish physician-turned botanist named Charles de I'Ecluse, more commonly known as Carolus Clusius, in 1605 in a monumental work on exotic plants and animals published in Antwerp with an abbreviated title referred to as <u>Exoticorum Libri Decem</u>. Explorers from Holland had provided the dried specimens from which Clusius made his observations, drawings, and notes (Vogts, 1958.) Although the early navigators of virtually every seafaring nation were on exploration for the sake of commercial non-horticultural enterprises, the length of the journey and the understanding that the voyage would take them to new and as yet unexplored lands merited sponsorship by wealthy merchants or influential nobles or citizens who satisfied their own vanities in selecting certain members of the crew. Each of these wealthy sponsors had an extensive estate that included a formal garden. So in addition to the sailing crew, a medical technician, and perhaps other personnel sent for express purpose, a botanist was routinely dispatched on these voyages to bring back specimens (living, if possible, or dried on voyages where the years at sea made that form more realistic) either to advance botanical knowledge, or to add to their own garden and enhance its (and their) distinction (Vogts, 1958; Seaton et al. 2014)). Various *Protea species* were brought to Europe in the 1600s and early 1700s by these various explorers. Linnaeus named *P. cynaroides* in 1735 making it possible afterwards to actually track the development of that particular species.

While many botanists and gardeners planted and studied various *Protea species*, including *P. cynaroides* in a number of European locations in the 17th, 18th and 19th centuries, most of what was recorded added to the body of knowledge of physical descriptions of the various species rather than cultivation notes. Collecting specimens as well as building the body of knowledge about the species was essential to learning how to successfully cultivate the plants themselves. That knowledge base evolved by trial and error through the efforts of many people who still remain unrecognized simply because they were regarded as just lowly gardeners and not the scientists their experimental horticultural work actually merited. There are some notable exceptions. A master gardener only referred to as Auge worked for the Dutch East Indies Company. Auge was sent on several excursions to bring back exotic plants including Proteas, which undoubtedly included the *P. cynaroides* species and successfully cultivated them all in the Company's own corporate exotics garden which was renowned throughout Europe. Other notable collectors who participated in or directed cultivation of various *Protea species* in Europe during this period were Carl Thunberg of Sweden and a contemporary of Linnaeus; Francis Masson of Scotland who sailed to South Africa with Captain Cook for the Royal Botanic Gardens at Kew near London; James Niven also of Scotland; and Joseph Knight of England who became an expert on cultivating the known *Protea species* and authored the first book on cultivating plants of that genus entitled On The Cultivation Of The Plants Belonging To The Natural Order Proteaceae in 1809 (Seaton et al. 2014). Each of these individuals not only collected plants for their masters' estates, they cultivated them there as well (Vogts, 1958). Interestingly, upon his retirement, Knight's master, George Hibbert, gave his extensive *Protea* collection to Knight which Knight then used to start his own commercial nursery business, The Royal Exotic Nursery. Thus, Knight has the distinction of becoming the first person to commercially cultivate and sell *Proteas*.

Cultivation of *Proteas* and other exotic plants in Europe during the 18th century was accomplished in the highly artificial environments of hothouses and greenhouses that used heated air for warmth. Such heated air was dry, created by burning natural fuels such as wood, which provided, by accident, a critical component for *Protea* cultivation. All *Proteas*, including *P. cynaroides*, flourish in dry climates, so the *Proteas* grown in such European cultivation systems flourished until the advent of the industrial revolution and with it, the wide application of the steam engine as a power source. The end of the 19th century, when hot water and steam heating became commonplace and eventually replaced the former dry heat system in propagation and cultivation houses, marked the drastic decline and near demise of *Protea* cultivation in all parts of Europe. The plants simply could not survive in the constantly humid environment the newly converted conservatories featured. And they still can't. Thus, the switch in environmental systems brought on a stylized Dark Age for *Proteas* in England. Great Britain, during the 18th and 19th centuries, seems to have had the biggest repository of cultivated *Proteas* in Europe (Vogts, 1958). English botanist Sir Joseph D. Hooker attributed the decline of *Protea* cultivation there to the conversion to humidity-based heating systems and overwatering the plants (also a lethal action to any *Protea species*). And with the decline of cultivation of the plants came a return to ignorance of their propagation and growth requirements by horticulturists, young and old.

Horticulturists in Europe during the 17th, 18th, and 19th centuries experimented trying to understand and perfect cultivation practices. In South Africa, the home of origin for a huge number of *Proteas*, including *P. cynaroides*, no such attempt was made even as late as 1946 for the simple reason that even though the plants grew there in the wild, they weren't considered exotic enough by the native population to warrant interest or demand. Ironically, what was considered exotic – and thus most desirable - to South African floral customers were the common flowers of Europe in the northern hemisphere which were not native and thus unusual in the southern hemisphere. So the “exotic” flowers of Europe were the flowers in high demand and commercially cultivated and sold in South Africa, not the extraordinarily beautiful, bountiful and available native *Proteas*.

Although *P. cynaroides* as well as other species are native to South Africa and have grown naturally there since before recorded time, astoundingly, commercial cultivation of any *Proteas* in South Africa did not begin in earnest until after World War II. The foundations for a South African commercial enterprise were being laid in the first half of the 20th century by early pioneers putting together the necessary components which commercialization would require. South African Harry Wood was the first person that secured a commercial license to harvest wild *Protea* flowers from the native fynbos area. Later, Walter Middelmann and his wife Ruth who owned Honingklip Nurseries gathered *Protea* seeds in the wild and sold those commercially, providing the only seed source for awhile for other collectors/growers. Probably the greatest single earlier contributor was Frank C. Batchelor, who spent nearly thirty years between the 1940s and 1970s collecting *Protea* specimen plants from the wild, which included natural hybrids as variants. Batchelor experimented with propagation techniques, and taught himself through trial and error how to vegetatively propagate the plants, thereby creating his own nursery stock which he grew exclusively for the cut flower market (Leonhardt and Criley, 1999). He developed quality standards for cultivating the plants he marketed both within South Africa and internationally (Parvin et al. 2002).

In 1958, Dr. Marie Vogts, a South African who spent over twenty years studying and cultivating every species of *Protea* native to her country thus becoming an expert on Proteas, published the definitive book on cultivating plants in the genus entitled *Proteas*: Know Them And Grow Them. The publication of her book ignited (in South Africa and other parts of the globe) and re-ignited (in Europe) interest, new research, and the introduction of commercial cultivation of *Protea species*. Dr. Vogts concluded that *Proteas* could be cultivated anywhere as long as the propagation and cultivation requirements were understood and followed. She and others have indicated that a considerable global economic market for these plants as cut flowers existed and continues to grow annually (Brits et al. 1983; Parvin et al. 2002). However, horticultural scientists and the South African government became concerned that the growing cut flower market for *Proteas* had already had a negative impact on the plants' environment and future. In 1965, The South African Wildflower Growers Association was formed to begin a more managed, research-based and conservation-minded approach to harvesting and marketing the wildflowers. In 1976, the organization evolved into its current form, The South African *Protea* Producers & Exporters Association (SAPPEX), which expanded the original mission to include cultivation of the plants. One of a number of commercial cultivation techniques, which came from the research, promoted through these organizations that are still used by growers today is the broadcasting of *Protea* seeds in rows for plantation planting.

Across the southern hemisphere in the same time frame, Australian growers were also gravitating toward a shared and more scientific approach to commercialization of their own *Protea* market. Peter Mathews of Proteaflora Nurseries outside of Melbourne took advantage of the gathering of

Horticultural Scientists from around the world that came to Sydney in 1978 for the 20th International Horticulture Congress. Mathews sent an invitation to participants who had an interest in growing *Proteas* in their home countries to have a private meeting of their own before the conference ended to network and discuss how they could help each other. Participants in this sub-conference included growers from South Africa, Israel, Hawaii (US), and New Zealand in addition to their Australian hosts. An outcome of the meeting was the decision to establish a *Protea*-specific international organization. That goal was realized in 1981 with the formation of the International *Protea* Association (IPA), which hosts conferences that rotate in location among its member nations every two years. But the IPA was a stand-alone organization and members realized early on its limitations. So the IPA subsequently created The International *Protea* Working Group (IPWG) which was formed in 1984 under the auspices of the International Society for Horticultural Science (ISHS) in order to access research funding as well as link scientific researchers together for a more coordinated and efficient use of research resources (Brits et al. 1983; Parvin et al. 2002). However, in spite of the cumulative work completed over hundreds of years, *Proteas,* in general, and *P. cynaroides,* specifically, remain undomesticated plants today (Resendiz, 2015; Perry, 2015; Leonhardt, 2015; Kravitz, 2015).

Researchers, horticulturists and growers from around the world continue to spark new interest in growing *Proteas* commercially. However, the genus' growing requirements particularly with respect to climate and soil severely limit locales for serious consideration. The small start-up group of five commercial cultivation nations has today expanded to include the original members as well as Portugal, the Azores, the Canary Islands, Chile, Ecuador, Zimbabwe, and San Diego county in California (US) (Gerber, 2014). IPA and IPWG continue to promote and share research on propagation, cultivation, and marketing of *Proteas* for primarily the cut flower market. Many growers have developed a miniscule small side market for selling stock plants to landscapers or in retail outlets for direct sale as landscape plants to homeowners, but this is limited to their individual immediate locales as the required habitat for successful growth of *Proteas* is so extremely limited. The vast majority of growers have small farms, which, unfortunately, result in higher production costs and limit research and development of new hybrids to what the farmer can manage from his already tight budget.

Getting a sense of the value chain for producing *Proteas* in general is, realistically, nearly impossible. According to the most recent figures published in 2014 by the IPA, only about 200 *Protea* growers worldwide are commercially growing plants of this genus and nearly all of the production on these farms is for cut flower harvest. The lack of standardized and required statistics at both the national and international levels up until the present time has been a huge roadblock to the group's ability to engage in and accomplish any long term planning – it's hard to improve what isn't measured (Gerber et al. 2012). However, there are bits and pieces of the puzzle that have surfaced.

There are several seed producers that supply seeds for global customers (Hoffman, 2015). Rather than being distributed through large seed companies, however, it appears seed distributors are small independent growers who sell the seeds they harvest from their own crops, or associations of small farmers (the bulk of *Protea* growers world-wide) who pool and market their seeds. Seed producers are found in nearly every producing country. It appears they use as brokers local, regional or national *Protea* growing organizations. Some seeds may be purchased commercially, but most growers are collecting and growing their own seeds or vegetatively propagating plants to expand their plantations (Resendiz, 2015; Perry, 2015; Kravitz, 2015; Hoffman, 2015). Seeds are also marketed to private consumers.

Global commercial growing of *Proteas* is done almost exclusively for the cut flower market (Hoffman, 2015). This is also true for North American *Protea* farmers (Resendiz, 2015; Perry, 2015; Kravitz, 2015; Leonhardt, 2015). There is no one larger than the individual farmer who keeps track of area of production by species, and if such data is kept on an individual farm, it is for internal consumption only and not collected and published. The small growers may or may not sell to landscapers in their immediate region, but any such sales are usually done on a wholesale basis, not retail. Every *Protea* grower does his/her own thing in “Wild West” fashion (Perry, 2015) - whatever works to turn a profit is that grower’s business model.

Figure 2 shows a general depiction of what various distribution pathways are used by Southern California *Protea* farmers in this “Wild West” model, but none of the farmers use every pathway depicted in this model. For example, while virtually all farmers who buy *P. cynaroides* seed order those seeds directly from suppliers in South Africa who harvest their seeds directly from the fynbos, most are propagating new plants from vegetative cuttings they make themselves from their own plantation stock, growing their own cuttings and finishing them as landscape plants either to sell wholesale to landscapers or expand their own commercial plantings for the cut flower market. But some growers cannot propagate a sufficient amount to meet their own expansion and commercial sale needs, so they contract with other local growers who have that greater capacity. Some growers sell cut flowers directly to customers via phone or web mail order systems; others do not engage in mail order direct to customers. Some sell cut flowers only to bouquet makers; others sell to a combination of bouquet makers and floral cut flower middlemen. Some growers sell only to wholesale landscapers, while others sell to retail outlets as well as wholesale landscapers. No California *Protea* farmer currently sells containerized landscape plants retail directly to consumers, but two growers are planning to introduce that pathway to consumers by 2017 on a very limited basis (Resendiz, 2015.)

In the US, small local retail outlets that may carry live containerized plants are extremely limited in their supplies simply because of the small number of producing growers in any given location, the restricted growing area of the plant, and the low surplus plant production numbers. If area is available for planting, growers will use it to expand and support their primary value stream – cut flower production. Growers who do supply live plants on a wholesale basis restrict sales to within a very small radius to ensure plant viability and minimize transportation costs.

No figures, facts, or distribution network data are available for not-for-landscape potted *Proteas* in general or a not-for-landscape potted *P. cynaroides,* specifically, because neither product currently exists anywhere in the world. However, *P. cynaroides* is one of the most commonly and easy to grow species, so commercial farms growing *Proteas* more than likely have *P. cynaroides* in cultivation. Again, this specific data is not collected nor reported for US *Protea* growers.

The common features of the existing non-standardized distribution system used by those who grow and sell *Protea* for the cut flower and landscape plant market (Figure 3). Most North

American *Protea* growers function as propagators-growers-finishers. The direction arrows shown in the two product line distribution chains indicate the distribution of product down to the consumer level via anticipated demand from various wholesale buyers/outlets. However, in some cases consumers can order retail direct from the grower, or they can order direct from the flower bouquet retailers, both pathways shown with two-headed arrows.

North American "WILD WEST" Distribution Chain for Protea

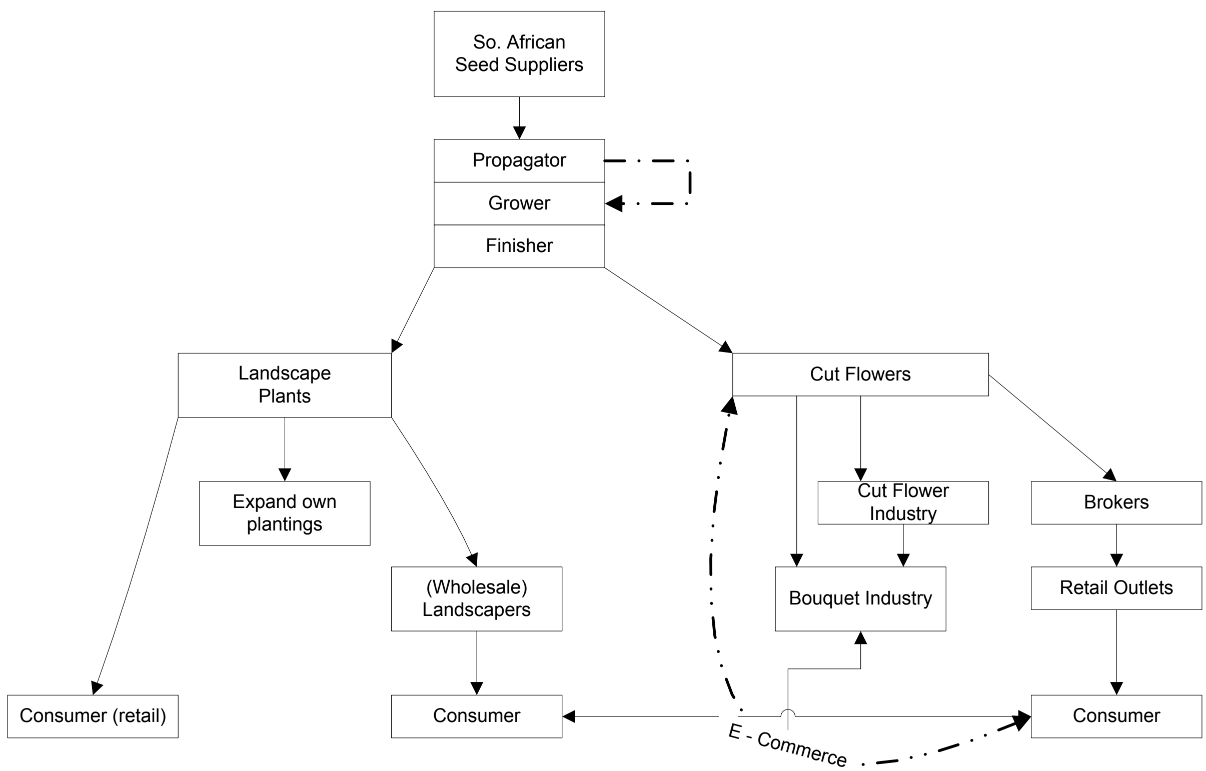


Figure 3. North American "WILD WEST" Distribution Chain for *Protea*
Note: Not every farmer uses every part of the model, only those that provide the greatest profitability to the individual organization.

A dwarf cultivar of the King Protea aptly named ‘Mini King’ has been under cultivation in California at San Marcos Growers and Resendiz Brothers Proteas for several years. The cultivar is a wild variant from the Port Elizabeth fynbos area in South Africa (Leonhard, 2015; Armitage, 2015). Two other dwarf *cynaroides* cultivars have also been bred in South Africa: ‘Little Prince’ (Research Council – Vegetable and Ornamental Plant Institute) and ‘Tinkerbell’. Another named ‘White Crown’ has been developed in Australia by Ausflora Pacific (Sadie, 2015). All of these cultivars seem both suitable targets and likely starting points for developing a smaller sized *P. cynaroides* for the proposed seasonal potted plant expansion campaign (Leonhardt, 2015; Resendiz, 2015; Perry, 2015). There is huge market potential for such a product if it could be developed and produced in sufficient quantities. There are also inherent challenges in propagating, cultivating, distributing, and creating demand for a novel seasonal exotic plant that must be overcome. Clues to overcoming those challenges lie in what has already been accomplished.

III. PROPOSED CROP TRANSFORMATION

A. Current Production Practices.

It should be noted that the current production of *Proteas* in North America as well as around the world varies in the particular practices used andalso in what is necessary to be accomplished in the timeframe needed to achieve the specific desired product: landscape plants and/or cut flowers. The following Current Production Schedule (Table 2) does not accurately depict a method for producing a potted holiday version of a generic *Protea*, nor does it in any way reflect a targeted method for cultivating *P. cynaroides*, specifically. It is, in fact, a conglomeration of methods currently in use by a number of North American growers. The schedule reflects a combination of methods/ timings currently in use to produce any kind of *Protea* for landscape and cut flower markets. It does depict actions through harvest for each respective market. Because these plants are grown specifically for the outdoors (landscape or plantation growth for cut flowers), an inherent design within the schedule is to get the plants and keep them outside where production costs are lower as quickly as possible. This is possible because of the limited climactic conditions in a targeted geographic area: coastal southern California. Mist houses are used for propagation only (up to 120 days) (Perry, 2015; Resendiz 2015). Hardening "houses" are semi-open, covered shade houses (90% shade cloth covered) with windbreaks on one side to allow for air circulation, but protect against high winds that could damage young developing plants.

Table 2. Current North American Crop Production Schedule (*Proteas)*
(Kravitz, 2015; Perry, 2015; Resendiz, 2015)

Week,Year	Production Activities
wk36, yr 0	order cuttings for following year (6" terminal shoots) if can't self-produce
wk 34,yr 1	stick cuttings treated with 8000ppm IBA in 5" deepX2-3/8" wide liners filled with propagation mix 90% perlite+10% peat moss, place in 90% shade covered mist house (70-78F)with misting @ 5-45 minutes sufficient to keep leaves wet/cool to ambient air temp, rotating fungicide program 1Xmo thereafter
wk42, yr1	callus forms (30-45 days), add bottom heat (70F) stays in mist house until rooted (60-120 days)
wk10, yr2	transplant rooted plants to 4" air pot filled with 50:50 mix of acidic soilless mix/eat moss and perlite, place outside or in hardening house under 90% shade cloth to grow on; 1 month after transplanting, fertilize with dilute mix of urea +potash+iron+zinc, thereafter 1X mo; irrigate early in day 2Xweek
wk12, yr2	soft pinch terminal shoot
wk 36 yr 2	transplant to I gallon containers with 50:50 mix acidic soilless mix/peat moss:perlite; trim roots; rotating fungicide drench @ 4 months from now on; put outside in sun to grow on; irrigate @ 5-8 days early in day; fertilize with dilute urea, potash, iron and zinc mix - no potash
wk 10, yr 3	transplant to 5 gallon container; soft pinch to form lateral shoots; fertilize with dilute urea, potash, iron and zinc mix - no potash; for field expansion, plant out in field.
wk 38, yr 3	fertilizer push as above
wk 10, yr 4	FBI, fertilizer push with increased potash and decreased N
wk 22, yr 4	fertilizer push with increased potash and decreased N
wk 36, yr 4	FBD
wk 38, yr 4	fertilizer push with increased potash and decreased N
wk 44, yr 4	anthesis; ship in containers to wholesalers; cut flowers in field for cut flower market and ship

Although seed propagation is used, it is restricted to starting new seedlings for consideration in developing additional cultivars for in-house use or, later, breeding. Seed propagation is extremely time-consuming and risky. *Protea* seed germination rates are notoriously low – 10% is average (Resendiz, 2015). Plants take three to four years of growth before they are mature enough to bloom. This is critical for the cut flower market, which currently provides the biggest market share of *Protea* sales to growers.

Seed propagation is accomplished using foundational information from the early researchers and propagators. It was the only method of propagation until the 1970s (Brits et al. 1983). While it is possible to propagate seed using just media and water, using smoke saturated solutions of water (Liquid Smoke™) as a 24 hour soak prior to planting takes advantage of the plant's native defense systems: seeds germinate well in areas devastated by fire. Chemicals in the smoke help to break dormancy and hasten germination. The soaks have become standard practice when propagating by seed. Many seed suppliers also provide Liquid Smoke™ cloths as part of the seed purchase.

After soaking, seeds are planted in a combination mix of 1:1:1 peat moss, perlite and acid medium. Natural germination conditions are emulated as much as possible, so light is not a factor. Mist house temps are kept between 20-23C. (Bottom heat can be added if unseasonably cool temps are experienced.) Seeds are planted to a depth of about twice their diameter and kept moist, but not overwatered. Germination occurs in 3-4 weeks (Resendiz, 2015: Perry, 2015; Kravitz, 2015).

The preferred method for propagation on a large scale, however, is via vegetative cuttings (Resendiz, 2015; Perry, 2015; Kravitz, 2015). There are a number of reasons for the preference:

- Reduces time to flowering by over a year;
- Allows guarantee of the cultivar the grower wishes to produce and grow or sell;
- Has a much better germination return than seed propagation;
- And because of the better germination rate, actually costs less than seed propagation over time.

North American *Protea* growers are relatively small operations. By economic necessity, they try to be as self-sufficient in their operations as they can. Virtually all of them propagate their own vegetative cuttings. The three largest growers will contract with each other as need arises to produce/sell more cuttings, such as when a large plantation expansion is anticipated. Otherwise, they propagate, grow, and finish their own plants.

Propagation involves taking 20-25cm terminal shoot cuttings, usually in late summer or early fall (Leonhardt and Criley, 1999; Resendiz, 2015; Perry, 2015; Kravitz, 2015). The plant is hard to root (Kravitz, 2015), so the cuttings are dipped in a high concentration rooting dry compound or solution with IBA levels averaging 4,000 – 8,000ppm (Leonhardt and Criley, 1999; Resendiz, 2015; Perry, 2015; Kravitz, 2015). Some growers add NAA in alcohol at 3,000-6,000ppm to the rooting medium (Perry, 2015). The cuttings then are stuck in flats with 120 cuttings. The preferred rooting medium is 10% peat moss and 90% perlite. Cuttings go into the mist house with misting intervals adjusted to keep the leaves wet and the house temperature as close to 21 –

25C as possible. Callus is usually formed within 30-45 days. Rooting takes up to 120 days. A rotating fungicide drench is provided monthly while rooting takes place. Lateral shoot cuttings may be used when insufficient terminal shoots are available. However, lateral cuttings do not have as high a success rate as the terminal cuttings in successful rooting (Perry, 2015).

When roots are fully formed, they are transplanted into 10cm x 10cm pots, 12cm x 15cm liners, or 4" pots. Growing medium is purposely designed to provide necessary drainage: a 50:50 mix of peat moss and perlite. The planted cuttings are placed in a shaded hardening house until spring. A variety of structures serve as shade/hardening houses that provide 90% shade. Some are open on three of four sides, the fourth side closed off to serve as a windbreak against the prevailing winds, limiting the young plants from drying out and their need for more water. Some houses feature retractable shade cloths, which reduces movement of plants when it is time for them to be out in the sun later in the schedule. Quonset huts are also used, but must provide airflow options as breezes are a required element of the plant's optimal growing environment. Fungicide treatments continue monthly on a rotating compound schedule (Perry, 2015)..

Once plants are transplanted and put in the hardening house, they are fertilized with a proprietary mix of urea, potash, iron and zinc (no potash). *Proteas* grow well with low concentrations of fertilizer (Leonhardt and Criley, 1999). Irrigation occurs twice a week, on average, during this phase of growth and are made early in the day. Extremely dry weather may necessitate an additional watering (Resendiz, 2015; Perry, 2015).

After three months in the hardening house, the plants are pinched back to encourage branching and transferred into 2 gallon containers and put outside in the sun and wind for the next six months. Irrigation is provided every five to eight days, depending on weather, in the winter, and twice per week in the summer months. Fungicide treatments at this point are reduced to three times per year. After six months, the plants are then transferred into 5 gallon containers and remain outside in the elements permanently until they are sold or planted. Beginning in their second year, nitrogen fertilizer as soluble ammonium sulfate is applied through a drip irrigation system, with a full year's dose evenly divided among two or three applications. Young plants can be sold after 22-24 months from cutting, but will not reach flowering maturity for another 12-24 months after that (Resendiz, 2015; Perry, 2015).

Pests are unusual. Infrequent white mealy bug or more rarely, scale problems do occur. Plants are scouted routinely for signs of either. Malathion or Orthene is used to control Mealy bugs. Oil-based treatments are used for scale. Once the plants are moved outside, squirrels can be a problem. Squirrel bait can be laid down monthly, if they become a problem. Gophers are trapped if they appear. Currently, there is no preventative regimen for pest control: treatment is provided on a per need basis (Resendiz, 2015; Perry, 2015).

Propagation by grafting and tissue culture has been investigated, but has met with limited success (Ferguson, 1999). Wedge and bud grafting have had limited success; splice and whip grafting techniques have also been attempted with similar limited success.

Landscape companies and their commercial and residential customers are only interested in the containerized plants. For those economy-minded customers, 24-month-old plants are the best buy as they are the most economical. For those who prefer the gratification of a mature plant, older more costly plants are more desirable. However, the supply of *Proteas* both as containerized landscape plants as well as cut flowers is insufficient to meet current demand (Kravitz, 2015; Resendiz, 2015), so supplies of older plants may simply be extremely limited or completely unavailable. Prospective residential customers are limited geographically to the extreme southern California area simply because the climactic conditions needed for the plant to successfully grow are restricted to that area.

Cut flower customers are found nationwide. Bouquet makers have developed as a niche market and are a set part of the distribution chain (Figure 3). Customers can purchase cut *Proteas* directly from some growers via mail/phone order. They may also purchase through bouquet makers who supply big box chain stores, or they may purchase *Proteas* from florists who purchase the flowers either directly from the grower or from the floral industry organizations (Resendiz, 2015; Perry, 2015; Kravitz, 2015).

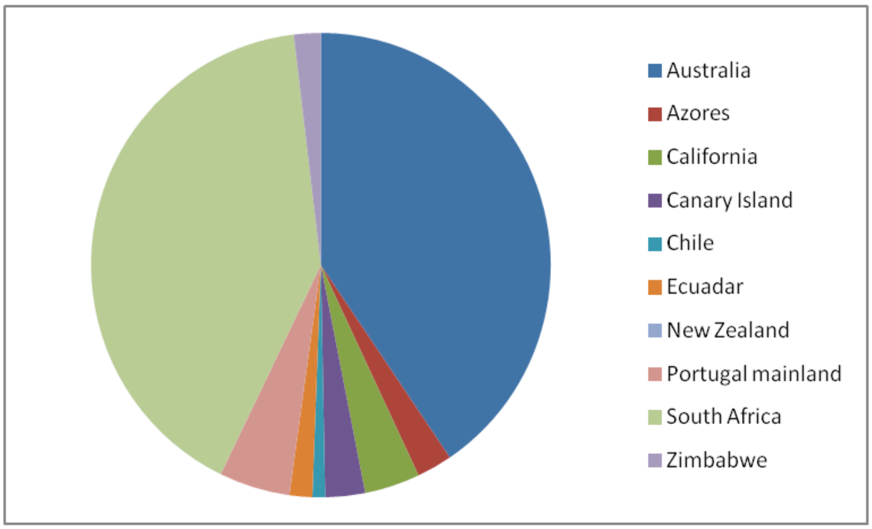
Growing *Proteas* is both an art and a science (Perry, 2015). What it often isn't, however, is economical or efficient. Capital investments in higher efficiency equipment are expensive. For all southern California growers, electricity and water are the biggest challenges as well as the biggest expenses. Water is at a premium in this location, not only for irrigation, but for residential consumers. San Diego County has invested in desalinization equipment – a huge capital investment beyond the financial capability of even the top grower. Electricity is also expensive. The highest potentials for efficiencies in future production lie squarely in those two areas.

Current Production Information and Statistics

Statistics for the global or even national production of *P. cynaroides* L. are sketchy, not available or are extremely outdated simply because such data is not collected in that detail in any country growing *Protea*. Getting meaningful data that is inclusive and collected in a relatively similar timeframe is impossible and, according to the International Protea Association, is the biggest challenge that growers around the world face in facilitating improvements (Gerber and Hoffman, 2012). As of the year 2000, an estimated 6,000 hectares of *Protea* of all cultivars were being grown globally. Approximately half that area (3,000 hectares) was found in South Africa. Australia and the United States (including Hawaii and southern California) each contributed 1,000 hectares to the total production figure. The remaining 1,000 hectares was composed of small farms in Portugal, Spain, Japan, China, the Azores, the Canary Islands, and central and South America. However, with the global economic downturn, growth in production has lagged or, in some growing countries, diminished (Dorrington, 2008).

Figure 4. Total Global *Protea* Production (hectares) By Country. (Gerber and Hoffman, 2012). Note: reported statistics vary in currency.

Australia (890ha)	40.50%
Azores(56ha)	2.50%
California (86ha)	3.90%
Canary Islands (60.5ha)	2.80%
Chile(20ha)	0.90%
Ecuador(36ha)	1.60%
New Zealand (unknown)	0.00%
Portugal (110ha) (mainland)	5.00%
South Africa(900ha)	40.90%
Zimbabwe (41.5ha)	1.90%



There is a similarity in the profile of *Protea* growers, regardless of their country. Large operations are limited, even rare. In North America, there are currently 100 *Protea* growing operations working over 404 hectares (Resendiz, 2015). Only three of the plantations are considered large producers; the vast majority of farmers are working less than 4 hectares, and that is representative of the global farming group. The relatively small number of contributors to the *Protea* farming operation around the world are shown in Table 3.

Table 3. Global *Protea* Growers By Country Of Production. (Dorrington, 2008).

COUNTRY	**NUMBER OF *PROTEA* GROWERS**
Australia	510
Azores	33
US - California	100
Canary Islands	80
Chile	8
Ecuador	3
New Zealand	4
Portugal	10
South Africa	150
Zimbabwe	33

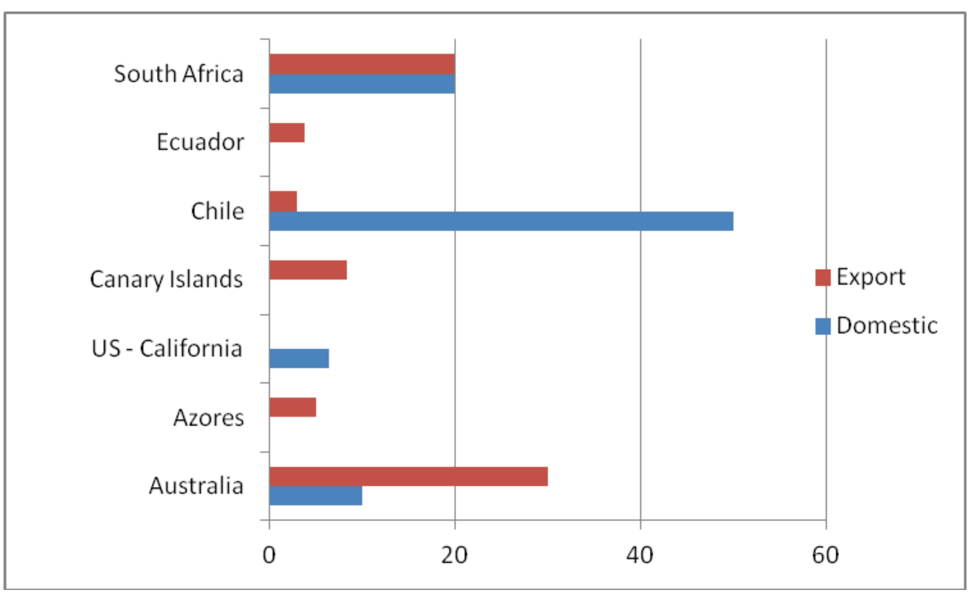
No statistics exist for specific cultivars in production for any producing country. Rather, reporting, when it is done, generally groups large group data together. However, a cultivar of

Leucadendron, 'Safari Sunset' is mentioned often as easy to cultivate and produce and well received in the cut flower market (Schiappacasse and Olate, 2008).

Sales of *Proteas* for the cut flower market are the only sales figures currently available. These figures, too, are broadly reported as total sales. The International Trade Center publishes its weekly flower sales report, Market Insider, which does make a distinction between King *Proteas* sold and "Other *Proteas*."

In 2008, the estimated Total Gross Market Value for the sale of *Proteas* on the global cut flower market was listed as US$174M (Dorrington, 2008). Figure 5 shows those countries for which financial sales data was collected and made available.

Figure 5. Estimated Annual Sales (2008) in Millions of US Dollars For *Proteas* on the Global Cut Flower (Domestic and Export) Markets (Dorrington, 2008).



It should be noted that only 25% of South African cut flower sales represent cultivated *Proteas.* The other 75% comes from flowers growing wild in the veld within the fynbos, but authorized for harvest and sale by the South African government (Dorrington, 2008). Sales figures that do exist no dot break down to specifically *P. cynaroides,* and they represent cut flower sales only.

No sales statistics for *P. cynaroides* were available for New Zealand, Portugal, and Zimbabwe. Neither Domestic nor Export data was unavailable for Azores, Canary Islands, and Ecuador. California sold exclusively to its Domestic market. No producing country's flower sales constitute a major factor in that country's GDP.

Production sites within the *Protea* producing countries are all located along coastal areas to meet the natural growing requirements of a sunny, breezy Mediterranean climate with nutrient poor soils that are found in the *Protea*'s native habitat:.

- AUSTRALIA – Western Australia, South Australia, New South Wales, Victoria, Queensland, Tasmania;
- CHILE – near Santiago;
- PORTUGAL (mainland) – southern tip;
- AZORES – islands of Sao Miguel, Terceira, Santa Maria, Graciosa, Sao Jorge, Pico, and Faial;
- SOUTH AFRICA – fynbos area along southwestern/south coast;

- ZIMBABWE – near Mozambique;
- UNITED STATES, CALIFORNIA – San Diego county, into northern Baja California. (Hawaiian production of *Proteas* with the volcanic eruption on Hawaii which spread acid rain in the form of ash over the *Protea* plantations within the island chain. All production has ceased with the irreversible plant damage).

Over 1200 species were identified worldwide as of 2008 (Dorrington, 2008). Of those, approximately 250 are grown in North America (Resendiz, 2015). New species are constantly being hybridized. A worldwide problem in tracking the new hybrids is the fact that breeders working independently from each other often develop the same new cultivar but give it different names. As a result, the same genetic variety exists under multiple names. The International *Protea* Registry located in South Africa was formed to officially recognize with a standardized name every new cultivar that is submitted for evaluation (Resendiz, 2015).

For the containerized landscape plant market, plant height variations that are characteristic of a variety can be significant in the purchase decision of a consumer. However, this same consideration is a moot point for the cut flower market.

Proteas, in general, have little scent to offer. Their appeal is visual and tactile. Variations in color are distinguishers in consumer decisions. The most popular hues are pinks and reds (Resendiz, 2015; Perry, 2015). 'Pink Mink' is a popular "feather" cultivar. The 'Mink" series is a top seller (Resendiz, 2015; Perry, 2015). The series differs in appearance and height from *P. cynaroides*. The various cultivars and species bloom at different times with some overlap, but that fact is motivation for growers to grow numerous cultivars to achieve a bloom spread – and constant cash flow – over the entire twelve months of the year. That is consistently and easily done since *Protea* inflorescences can be in bloom for several months at a time.

The target cultivar for the proposed new holiday potted plant, *P. cynaroides* 'Mini King' is a wild dwarf variant. Dwarf plants, because there are so few, offer an avenue for breeding and further development as a potted indoor plant. However, numerous discoveries via experimentation must be accomplished to bring this new product to market.

A. Crop Production Change(s) for the Future.

When queried, the top three North American *Protea* growers stated that their biggest economic challenges were:

1. access to quality water;
2. water in sufficient quantity to meet the irrigation needs of their plants;
3. affordable electricity;
4. expanded cooling capability;
5. expanded planting area;
6. reducing general overall costs.

LONG TERM ACTIONS FOR CONSIDERATION:

It is not possible for a single grower to financially subsidize these improvements. However, exploration should be considered in seeking financial subsidy through the collective efforts of the California *Protea* Association, the California State Agriculture Department and Floriculture councils, and the California State Department of Commerce in cooperation with local and state municipalities and utility organizations, and federal agencies to construct desalinization plants in the immediate area. This would create needed quantities of water without diverting them from residential drinking supplies and guarantee the water needed. At a minimum, it would ensure a greater quantity of water is available in the future when population demand taxes dwindling reservoirs even more than it does today.

Desalinated water may yet need to have ion correction (Perry, 2015). De-ionizing equipment should be considered as part of the water generation plant, or as add-on equipment to the drip irrigation system at each farm, using the same application avenues for subsidies. In that way, proper quality of water can be controlled and maintained to optimize plant growth and health.

Electricity to run irrigation systems and energy-hog desalinization plants requires renewable energy sources. With persistent coastal winds, it makes sense to also pursue the establishment of offshore wind generators, at least in sufficient quantities to provide power for water desalinization. With today's emphasis on renewable energy and federal and state subsidies available, it is a course of action worth evaluating and pursuing collectively as commercial producers in a state whose commerce is so closely tied to agriculture.

High efficiency cooling systems including geothermal systems should be evaluated. Low efficiency aged units could be replaced if payback is fast enough. Additions of such equipment should consider high efficiency as the primary factor. Existing systems can be examined and evaluated at low or no cost by having the local utility company come out and do energy audits in buildings to identify what steps can immediately be taken to decrease waste, and educate personnel on cost-saving preventive maintenance measures. Farming operations do include a business office/end. Looking at how to make the business office end more efficient will free up financial and personnel resources to accomplish other needed tasks or subsidize other cultivation processes.

Land prices are down. For those who would like to expand planting area to generate more sales and higher profitability, buying up closed nurseries at bargain basement prices may be a good investment to consider.

SHORT TERM ACTIONS FOR CONSIDERATION

Look at what can be recycled but isn't, and what current recycling could be expanded. Is irrigation water recycled? Are drip systems used throughout the plantation? Can nutrient solutions be recovered and re-used? Use pull-based just-in-time ordering systems so less capital is locked up in inventory. Pooling orders to realize discounts on larger quantity orders usually generates savings. Consider forming buying alliances with other growers using the same supplies to order at reduced prices. Can supplies used be consolidated to reduce the number or products purchased? Establish an inventory process/system for each department and use it to avoid wasted capital tied up in forgotten or outdated supplies. In buildings that are heated or cooled, are there double doors to minimize drafts and temperature loss?

Examine each process from cutting and sticking through harvest. Where/what can be done to reduce time, motion, transportation, resources, and improve % yield?

1) Cuttings – how is the process laid out in the space provided? Are materials at hand? Do workers have to stop and leave their position to get supplies? How can they be supported to maximize work time, reduce waste, increase production?

   a. Experiment with various cutting/rooting techniques and concentrations to determine the one that provides optimal results - e.g. consider slightly bruising/smashing/scoring the cuttings before dipping them in the rooting medium. Keep up on the literature and make a point of testing and keeping track of two new methods each cutting cycle.

   b. Take cuttings only from healthy stock. If purchasing cuttings, ensure the stock used is healthy.

   c. Choose optimal rooting containers to balance space restraints, good drainage, optimal propagation numbers, and easy handling. Disinfest and re-use.

   d. Use rolling racks in mist houses to maximize space.

   e. Scan daily for and remove failing cuttings immediately to reduce risk of contamination, maintain sanitation, and free up space.

2) Rooting – is there a way to catch and recycle fertilizer solution if not using a drip system?

3) Rooting – is it more economical to root in new Jiffy strip bio-degradable pots?

4) Is there a way to reduce/minimize transport of plants moving from mist house to hardening house, from hardening house to outside areas? Is it reasonable to set up portable potting sheds where 2 gallon and 5 gallon transplant stations are rather than moving all the plants to a stationary potting shed?

5) What is the most economical construction for a shade house? Is shade fabric repaired to extend use? For retractable shades, does the means to do so protect the integrity of the fabric? If not, how could that be facilitated?

6) Are different locations for growth stages placed close together and sequentially? Is the layout of the growing-on areas conducive to smooth work flow? Is the flow of progressively growing plants minimizing plant relocation and thus man-hours?

7) Containerizing – are air pots being used to help reduce root girdling? Air pots allow exploring roots to die back on their own, limiting injury and other problems associated with girdling.

8) If mixing proprietary growing or rooting media, is sufficient quantity mixed to complete planting tasks without losing the high perlite content to blow away? Is medium covered between use to avoid loss?

9) How is work timed/scheduled? Is there a back-up pool of workers identified/recruited in the event of a crisis?

10) What is the most economical means of pinching? Is the operation set up to do that technique easily and quickly?

11) Since plants only produce flowers for 6 to 8 years of age, what percentage of annual propagation is dedicated to replacing existing plants? What is the replacement plan and how/when is it executed?

12) Is the plantation going to specialize in certain varieties? If so, which ones? Is there sufficient variety in cultivars to ensure even capital flow throughout the year?

13) Will the farm engage in plant breeding? If so, how will that be accomplished? How will the effectiveness of any new cultivar be evaluated?

14) Is there sufficient acreage to expand plantings to meet demand? If not, what is the plan to acquire the additional acreage needed? When and how will those acquisitions occur? How will they be funded?

15) Are automated spacers used to place plants? Is manual spacing easier or more cost effective?

16) How will pruning and shaping be done cost effectively?

17) What provision is made to handle weather extremes outdoors?

18) What is the marketing and sales plan to sell every plant at the highest margin the market will bear?

19) Is there a possibility for a new niche product that will take less production time but return a good profit for its uniqueness? (e.g. instead of a "Pet Rock", a "Pet *Protea*" that is a 1 year old plant after its second pinching.) Will the sale of such a product help or hinder overall profitability?

20) Dwarfing a cultivar as proposed would require periodic root trimming, as in Bonzai. How/where will that be done to ensure sanitation? Since the product is designed to finish as a potted plant which will need to be protected, what is the proper facility for that purpose?

21) Development of a bloom forcing regimen will be needed which will require some experimentation to identify. How long to allow for lead time for R&D? How long, once

developed, will it take to produce a sufficient quantity of the new cultivar for sale as well as sufficient cutting resource? What housing space requirements will be needed?

22) Would it be more efficient and effective to use "portable" buildings that can be quickly constructed at locations where plants are stored than transporting plants to fixed houses for finishing?

Production changes can be planned in advance to a certain extent. But the best preparation will be in the responsiveness the farmer has to challenges that come up as the new production process is undertaken, remaining open to change and improvement, and willing to make adjustments in cultivation processes to achieve greater efficiency and effectiveness.

B. A New Production Schedule.

Since containerized *P. cynaroides* production has never been attempted, creating this new product will require a considerable amount of experimentation in order to zero in on the most optimal timings and combinations of methods, PGR sequencing and concentration and applications, growing methods and scheduling, and actual cultivar development and selection.

As noted, there are several dwarf *P. cynaroides* cultivars now available that could serve as starting points for plant breeding to develop the ideal phenotype for the containerized product: 'Mini King', 'Little Prince', 'Tinkerbell', and 'White Crown'. It is absolutely necessary for that breeding effort to achieve or get extremely close to the ideotype outlined in the next section for the new product campaign to be successful. While none of the existing cultivars offers the perfect phenotype as it exists today, it is unknown how these current cultivars would respond to PGR application because PGR's have not been tried on the plants yet with few exceptions – IBA treatments on vegetative cuttings to facilitate rooting, and 6-BA on terminal shoots to hasten flower development and anthesis (the latter research done on *Protea* 'Carnival' only) (Hoffman 2006). Many related details will need to be determined based on the findings from this required research, and it will involve the slow work of trial and error experimentation on a slow growing plant.

According to *Protea* growers Mel Resendiz and Dennis Perry, there is no reason to believe that PGRs could not be successfully used to manipulate the growth and flowering of *P. cynaroides* plants (Resendiz, 2015; Perry, 2015). However, the proposed crop schedule offered below is based on the anticipated effect a grower would expect from the application. It is very likely that, after research and experimentation, a much more effective application and growth plan for the crop schedule would be developed prior to the commencement of commercial production. An ideal outcome of this research would be the development of a Protea-specific version of the Widmer Method for reducing flower bud development time for *Cyclamen persicum.*

The following proposed crop schedule is to produce a containerized potted version of *P. cynaroides* for the holiday market (Table 4). Actual production will take approximately 2 years, but preplanning in terms of ordering or producing terminal cuttings for sticking will add an additional 5-6 months to the planning effort.

Table 4. Proposed Crop Production Schedule To Produce A Potted *P. cynaroides* For The Christmas Holiday Markey.

wk36, yr 0	order cuttings for following year (6" terminal soft shoots) if can't self-produce
wk 30,yr 1	stick wounded cuttings treated with 8000ppm IBA for 5 secs in 5" deep X 2-3/8" wide liners filled with propagation mix 90% perlite+10% peat moss, place in 90% shade covered mist house (22-25C) with misting @ 5-45 minutes sufficient to keep leaves wet/cool to ambient air temp + bottom heat, rotating Subdue/Heritage fungicide program 1Xmo thereafter
wk 36 yr 1	callus forms (30-45 days), continue bottom heat 22-25C stays in mist house til rooted (60-120 days)
wk48, yr1	transplant to 10cm X 10cm pots with same media proportions, soft pinch, lightly fertilize with low dose ammonium-based and low phosphate fertilizer. Place in production house with seasonal light photoperiod and 19-22C temps + early morning temp dip
wk 2, yr 2	fertilizer push as above
wk 6, yr 2	fertilizer push as above
wk10, yr2	soft pinch terminal shoots, transplant rooted plants to 4" air pot filled with 50:50 mix of acidic soilless mix/peat moss and perlite (1:1), place outside or in hardening house under 90% shade cloth to grow on; 1 month after transplanting, fertilize with mix of urea +potash+iron+zinc (75ppmNH4 - 0-5ppmP - 50ppmK), thereafter 1X mo; irrigate early in day 2Xweek
wk14, yr2	soft pinch terminal shoot, trim roots
wk18,yr2	soft pinch termiinal shoots
wk 36 yr 2	transplant to 12" containers with 50:50 mix acidic soiless mix/peat moss:perlite (1:1); trim roots; rotating fungicide drench @ 4 months from now on; put outside in sun to grow on; irrigate @ 5-8 days early in day; fertilize as indicated above; rotating fungicide drench @month, trim roots
wk 43, yr 2	return to production house with seasonal photoperiod and lower temps 16-20C , water 1xwk, continue monthly fungicide drench thereafter; last soft pinch leaving 3 main terminal buds unpinched, trim roots
wk 4, yr3	FBI
wk 10, yr 3	fertilizer push (1/2 dose of 0.8 oz ammonium sulphate/plant), trim roots
wk 25, yr 3	FBD - fertilizer push (1/2 year dose as above)
wk 30,yr 3	application of 6-BA to flower bud terminal shoots
wk 35, yr 3	application of 6-BA to flower bud terminal shoots
wk 45, yr 3	anthesis, foil wrap, harden off
wk 46, yr 3	ship

Growers have stated that they are extremely interested in producing this proposed new product if there was a viable and profitable new market for a containerized *P. cynaroides* (Resendiz, 2015; Perry, 2015; Kravitz, 2015), but they have several important considerations to take into account and prepare for:

1) What level of production increase do they need to prepare for?
    a. To make it worthwhile financially, each grower would like a guaranteed market for 1 million plants (Resendiz 2105; Perry 2015);
2) What changes in their current operation will be necessary?
    a. Do their plantations contain enough acreage for the needed extra plants? If not, is additional local acreage available at an affordable price?
    b. Are there currently sufficient controlled environment facilities to produce the added number of plants? If not, what additional facilities will be necessary?
    c. Is there sufficient personnel available to run the expanded operation?
    d. How will extra demands on water and electricity be secured and managed?
    e. Growers estimate a 2 year lead time necessary for them to ramp up production and make all preparations necessary to produce the potted *P. cynaroides* once the cultivar and determined methods were identified and became available (Resendiz 2015). This timeframe assumes the grower has acquired all resources necessary to produce the quantity of plants they intend to grow.
3) How will they finance needed changes until first profits are realized?

a. If land and/or new facilities must be purchased, how will financing be arranged and afforded?

b. If extra-ordinary utility acquisition is called for, how will that be achieved and if needed, with what partners?

4) How/by whom will the new product's market be created and sustained?

   a. A new marketing plan must be developed and implemented. Who will be involved? How will it be subsidized? What is the rollout plan?

5) Who will be involved in the new cultivar breeding?

   a. Individual growers or a consortium?

   b. How/when will sufficient quantities of the new cultivar be available to growers to start production?

6) How will the growers acquire the new cultivar from the breeder?

These questions must be addressed and answered fully before the new product campaign can be launched.

Other major challenges include but are not limited to: developing marketing and distribution plans, securing research funding, acquiring access to sufficient necessary physical resources, discovering and standardizing the details of the optimal propagation and production processes, and determining optimal product packaging/container size. These individual challenges require serious consideration as success of the new product campaign hinges on each.

Developing the new plant product market is as important as developing and producing the new cultivar and optimal cultivation practices: if there is no market demand created, no matter how many plants are produced, a profit will not be realized, especially when the new market is predicated on taking revenue from or building on a previous traditional habit of consumer spending. Marketing the new product on a national scale will require the collaborations of – at a minimum - growers, state and regional agricultural agencies and organizations, national floral growing and retail associations, and floral distribution entities.

Because of the cold weather prevalent over much of the US in the prime marketing season, the proposed new product would undoubtedly be sold through large garden centers, florist shops and chains, or big box stores with high turnover sales. Transportation will be a factor as plant environment must be controlled unless local finishing networks can be built that can accommodate the plant growth requirements for the last year of growth closer to final sales destination.

Grants through various foundations, both national and international (i.e. the IPA and IPWG) may be sources of research funding to develop the new cultivar in addition to California State Agricultural Commission and the California State department of Commerce. The California *Protea* Growers Association, at a minimum, must immediately adopt a standard requirement and protocol for collection and analyzing production data. Such data will be an essential requirement for any grant or funding application. There is currently no provision for nor standardized process for the collection or keeping of such data.

As stated earlier, a critical pre-production challenge to be solved involves securing necessary water supplies and electricity for production in a state already forced to limit those resources. Exploration should be initiated with the entities discussed in funding offshore wind farms and water desalinization plants to gain acquisition to increased amounts of those resources.

Other critical challenges to be worked out are the details of the propagation and growing process. Proposed plant production for the containerized *P. cynaroides* from cutting stick to flowering is 24 months and growers agree that this is achievable with PGR applications to hasten vegetative growth and flowering (Resendiz 2015; Perry 2015; Kravitz 2015). Vegetative propagation is now used exclusively commercially; that propagation method should be continued as it reduces growing time to flowering from seed germination by a full year. Currently, rooting can take up to 6 months. Callus formation occurs in 30-45 days. Flower bud initiation begins after the cooling period immediately before the planned flowering year (Spring of year 2 in the crop schedule). Flower bud development begins approximately 3 months before expected flowering date. Keep in mind, the current production schedule is achieved without the use of any PGR's besides IBA treatment on shoot cuttings to facilitate rooting. There appears to be plenty of opportunity to reduce growth time and speed up flower bud initiation and development using PGR's. Shipping should not occur until flowers have opened. Depending on the size of the inflorescence heads developed in the new plant, the individual bracts may need to have special shipping protectors as part of the plant packaging to prevent accidental damage. This would be determined as part of the research and development of the new plant product. Inflorescences are long-lived, so there is no concern that a shipped flower will deteriorate rapidly and have a short shelf life.

Based on conversations with retailers and growers (Resendiz, 2015; Perry, 2015; Kravitz, 2015; Bonning, 2015; Sanders, 2015), the optimal size container for the containerized *P. cynaroides* product would be a 10-12" pot. This size is optimal for several reasons:

- Allows for the area needed for a stable and well rooted foundation for the small shrub;
- Will allow the esthetic ratio to be achieved for visual presentation and customer appeal;
- Is within the limits of acceptable container size for storage in customer space;
- Supports the ability to meet a retail price point of $49.99 to $69.99, which have been determined as the upper limits for marketability (depending on socioeconomic location of retailer) and still provide the profit margin needed by the grower.

The goal of a breeding program would be to develop the optimal *P. cynaroides* cultivar to meet the requirements of the ideal phenotype for a containerized potted plant. That phenotype would offer ease of growth, care and management to propagators, growers, finishers, distributors, transportation agents, retailers, and ultimately, the consumer. The properties of that ideal phenotype have been identified.

C. The New Crop Ideotype.

The "Santa Wish List" for researchers to develop includes a dwarf *P. cynaroides* cultivar with the following plant characteristics:

- Show bract hues of shades of pink to red;
- Display the esthetic ratio in a 30.5cm (12") pot;
- Grow easily in that sized container without frequent, costly manual root trimming;

- Sustain a sufficient root network to grow and remain healthy;
- Propagate and root easily and quickly;
- Be responsive to PGRs for quickened and compact vegetative growth, forced flower bud to meet a scheduled bloom time;
- Maintain its drought hardiness at the point of growing on;
- Initiate and develop flower buds and achieve anthesis to meet blooming schedules;
- Produce at least three inflorescences in its first flowering year;
- Reduce time from cutting stick to flowering to two years;
- A plant able to tolerate indoor lighting and dry indoor environments throughout the winter months and then be taken outside as patio plant in the spring.

While there are significant challenges to be overcome as outlined in this paper, there are huge profits to be made by stakeholders and a new market niche to be captured. Horticultural trends traditionally last one to two years. The Poinsettia, as virtually the only traditional Christmas plant, is way overdue to be replaced. Unfortunately, up to this point there has been no viable option that has an innate persuasion to get consumers to consider something different.

Poinsettia marketing takes little effort to equate in consumers' minds the plant with Christmas. Tomie dePaola wrote about the traditional Mexican story of why Poinsettias bloom at Christmastime and are, thus, associated with the holiday in his book entitled, The Legend Of The Poinsettia. According to the legend, a little peasant girl came to honor Baby Jesus in a crèche display and had no gift to bring Him. A friend of hers told her that Jesus would be happy with any present she brought, so the little girl grabbed a handful of weeds by the wayside and put them at the base of the manger display where they immediately were transformed into the bright red flowers that are known as Poinsettias and bloom at Christmas. The star shape of the bract is said to symbolize the Christmas Star that led the Three Wise Men to find Baby Jesus. The red color of the flower symbolizes the blood of Christ. It's a story that certainly has established the plant as THE traditional Christmas flower. Up until now, there has been no challenger to offer the same rationale and excuse to break with old tradition and offer a novel and welcome change. But the King Protea does offer a creative mind the plausible story for that challenge: the flower isn't shaped as a stylized star, it is a star. The same Christmas Star/Wise Men symbolism can easily be applied, understood, and plainly seen. *P. cynaroides* also blooms naturally at Christmas time. In fact, its bloom time extends way beyond that of the *Poinsettia* so timing can scheduled for one plant to be blooming for Thanksgiving, Christmas and Valentine's Day. The "Legend of the King Protea" is just waiting to be written by a creative advertising agency and marketing firm. The novelty of the plant will offer a much needed alternative which may not necessarily diminish Poinsettia sales as it will offer an alternative to buyers who may purchase multiple plants as decorations for their home or office, or just want something different than the same old traditional holiday plant.

According to the 2013 USDA Floriculture Statistics report, Poinsettias were the top selling potted plant, accounting that year for 23% of sales of all flowering plants. That's $144 Million in sales just for one Christmas flower. A distant second was the Easter lily with sales of only $22 Million. The market potential for a competing Christmas flower with as good an appearance and rationale for its association with Christmas is huge. It's a giant market niche that could be easily dominated quickly, and offer substantial financial rewards to the opportunist who sees and acts on a golden opportunity. It is time to "Carpe Diem" and seize not just the day but a good chunk of a minimum of $144 Million in sales, and expand the total floriculture market beyond its present levels.

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